Draft Performance Work Statement (PWS)

for

Microgravity Flight Services

National Aeronautics and Space Administration

Neil A. Armstrong Flight Research Center

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1.0 INTRODUCTION

The National Aeronautics and Space Administration (NASA) has conducted microgravity flight services using both NASA and contracted resources in the past. NASA's current desire is to acquire microgravity flight services wholly through commercial sources.

This contract is to obtain support of NASA and NASA sponsored microgravity research using aircraft certified by the FAA to perform microgravity flight under Civil Aircraft Status. This Performance Work Statement (PWS) sets forth the requirements for NASA's Microgravity Flight Services Contract.

2.0 SCOPE

The Contractor shall provide all facilities, personnel, equipment, and tools to accommodate NASA experiments and personnel, obtain airworthiness and safety certifications, and prepare for and conduct flights to meet NASA's zero-gravity, partial-gravity, and hyper-gravity testing requirements. Perhaps it is most technically correct to call the acceleration effects created by parabolic trajectories "freefall" and "enhanced force," but for this contract they will be referred to collectively as microgravity.

The Contractor shall provide up to 20 microgravity flight weeks per year. A flight week normally begins on Monday with aircraft loading. Flights are then conducted each day, Tuesday through Friday. However, NASA can issue Task Orders that start on any day and conclude any day after two full flight days. Each flight shall include a minimum of 30 microgravity parabolic trajectories or constant-bank turns. The number of maneuvers intended on each flight shall be agreed between the parties, but the contractor shall not be required to exceed 60 maneuvers on a single flight, nor can the Government unilaterally require the contractor to deliver fewer than 30 without Contractor agreement. Aircraft unloading is conducted on the final flight day after the final flight is completed. Flight weeks will be conducted at the Contractor's facility. No access to NASA facilities will be provided.

NASA will provide or sponsor experimental payloads for the purpose of demonstrating technology and processes to increase readiness levels for application to space. Payloads may be human tended or autonomous, powered or unpowered, and may include hazardous materials or mechanisms. Most experiments will be secured to the aircraft interior. Some may be free-floating. Experiments may involve human subjects for training or medical research, or flight participants may simply be aboard for the "zero-g experience." Microgravity flight researchers come principally from the NASA Flight Opportunities Program, but experimenters also come from the NASA Human Research Programs and other specific NASA Projects and Programs.

Microgravity parabolic trajectories are normally within the design envelope of passenger type jet aircraft, however, the repeated parabolic trajectories are duty cycles which manufacturers did not consider in the design of their aircraft and engines. As part of a NASA Inter-center Aircraft Operations Panel (IAOP) review process, the Contractor shall provide to NASA the aircraft and

engine manufacturer's engineering evaluations demonstrating the suitability of the proposed aircraft and engines for the microgravity mission. The manufacturer's engineering evaluations shall include recommendations for aircraft and engine modifications, operations, life limitations, structural monitoring, and maintenance. The Contractor shall follow all recommendations made by the aircraft and engine manufacturers. The Contractor shall immediately inform NASA of any changes to the manufacturer's recommendations and provide the manufacturer's data to NASA.

NASA intends to conduct microgravity flight operations as Civil Aircraft Operations only. Therefore, the Contractor shall be responsible for the overall safety of the microgravity aircraft operations and maintenance as well as full compliance with all applicable Federal Aviation Administration (FAA) regulations. NASA maintains a responsibility to verify that payloads and operations have been properly analyzed and reviewed to minimize risks to personnel and property. Therefore, the Contractor shall operate and maintain their aircraft per the NASA requirements within this document.

The services available under this contract can be provided to any Federal Agency as approved by the NASA Contracting Officer (CO) and NASA Contracting Officer Representative (COR).

2.1 Applicable NASA Documents

The Contractor shall comply with the NASA documents listed below as referenced in this PWS:

DCP-X-046, Dryden Centerwide Procedure, Code X, Fatigue Risk Management

NPR 1800.1C, Chapter 2.0, NASA Occupational Health Procedures, Section 2.15, "Shift Work and Balancing Work-Rest Cycles"

NPR 8715.3C, NASA General Safety Program Requirements

NPR 7900.3C, NASA Aircraft Operations Management Manual

NPR 8621.1B, NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping

3.0 TECHNICAL REQUIREMENTS

The Contractor shall provide an aircraft capable of safely providing periods of zero, partial, and hyper (levels between 1.00 and 1.80) gravity to support the NASA research and development mission. The aircraft shall provide specialized services required by NASA experiments.

3.1 Gravity Level Requirements

The aircraft shall be capable of providing near zero gravity conditions, partial gravity conditions at Lunar, Martian, and asteroid gravities, as well as other specified levels up to

0.50 g. The aircraft shall also be capable of providing sustained hyper-gravity conditions up to 1.80 g for periods of at least 1 minute in duration. In the past this had been accomplished through constant bank-angle turn. The aircraft shall be capable of providing as many as 60 maneuvers (parabolic trajectories and constant-bank turns) per flight.

NASA microgravity profile requirements will vary for any given group of payloads and/or flight participants. In some cases the objective may be to maximize the duration of low gravity exposure with less emphasis on accuracy and stability. This would be most likely with a non-critical payload where the objective is to give the flight participant a zero gravity experience. In other cases the accuracy and stability of the gravity level may be critical and duration less important.

Three microgravity profiles, one hyper-gravity profile, and one combined profile are defined below. The profiles are described from the perspective of the payload or flight participant, not the flight vehicle. These profiles represent minimum requirements for microgravity exposure. Actual requirements may vary from those described here and will be defined in the flight week plan.

3.1.1 Definitions

- "Duration" refers to the length of time of stable microgravity
- "Accuracy" refers to the mean gravitational value for the duration of the maneuver.
- "Stability" refers to the absolute value of the maximum gravitational excursions from the mean value.
- "Lateral and longitudinal excursions" refers to the maximum absolute value of deviations from nominal zero acceleration, lateral (sideways) and longitudinal (forward and back) relative to the aircraft fuselage.
- "Entry and completion excursions" refers to the absolute value of positive and negative g forces encountered during entry and completion of the parabolic maneuvers prior to stable microgravity. This period shall be 3 – 5 seconds in duration.

3.1.2 Microgravity Profile 1 (M1): Exposure to Zero (0.00) Gravity - Accuracy Critical

The objective is to expose a science/technology payload to very accurate low gravity values without regard to the quantity of profiles per flight hour. Contractor shall provide microgravity, nominally zero (0) g, for a critical payload. Accuracy and stability of microgravity is very important. Exposure to longitudinal and lateral gravitational deviations and negative values of gravity may have a deleterious impact on the experiment.

3.1.2.1 Accuracy: +/- 0.01 g

3.1.2.2 Stability: +/- 0.01 g

3.1.2.3 Duration: not less than 12 seconds per parabola

3.1.2.4 Longitudinal and lateral gravitational deviations: not to exceed +/- 0.01 g

3.1.2.5 Entry and completion g excursions: not to exceed + 1.50 g or - 0.01 g

3.1.3 Microgravity Profile 2 (M2): Exposure to Partial (0.00 – 0.50) Gravity - Accuracy Critical

The objective is to accurately simulate the gravitational field present on the Moon, Mars, or on an asteroid. Contractor shall provide reduced gravity, nominally 0.17g (Lunar), 0.38 g (Martian), 0.03 g (asteroid), or a specified partial gravity level from 0.00 to 0.50 g for a critical payload. Accuracy and stability of microgravity is important. Exposure to longitudinal and lateral gravitational deviations and negative values of gravity may have a deleterious impact on the experiment.

3.1.3.1 Accuracy: +/- 0.02 g

3.1.3.2 Stability: +/- 0.02 g

3.1.3.3 Duration: Asteroid - not less than 20 seconds per parabola; Lunar - not less than 25 seconds per parabola; Mars - not less than 30 seconds per parabola.

3.1.3.4 Longitudinal and lateral gravitational deviations: not to exceed +/- 0.01 g

3.1.3.5 Entry and completion g excursions: not to exceed + 1.20 g or - 0.02 g

3.1.4 Microgravity Profile 3 (M3): Exposure to Zero (0.00) Gravity – Non-Critical

The objective is to maximize duration of low gravity exposure per flight hour for sensitive medical or scientific human test subjects and other experiments. Contractor shall provide microgravity, nominally zero (0.00) g, to a flight participant as specified by Task Order. Accuracy and stability of microgravity is not critical. However, excessively high positive or negative deviations shall be avoided because of potential risk to subjects.

3.1.4.1 Accuracy: +/- 0.20 g

3.1.4.2 Stability: +/- 0.20 g

3.1.4.3 Duration: not less than 20 seconds per parabola

3.1.4.4 Longitudinal and lateral gravitational deviations: not to exceed +/- 0.05 g

3.1.4.5 Entry and completion g excursions: not to exceed + 1.20 g or - 0.02 g

3.1.5 Microgravity Profile 4 (M4): Exposure to Hyper (1.00 – 1.80) Gravity

The objective is to offer hyper-gravity conditions from 1.10 g up to 1.80 g. These are typically accomplished by flying a stable, constant-bank-angle turn for the required duration of the experiment.

3.1.5.1 Accuracy: +/- 0.05

3.1.5.2 Stability: +/- 0.05

3.1.5.3 Duration: not less than 60 seconds per maneuver

3.1.5.4 Longitudinal and Lateral gravitational deviations: N/A

3.1.5.5 Entry and completion g excursions: + 0.05 g

3.1.6 Microgravity Profile 5 (M5): Exposure to Combined Hyper- and Microgravity

The objective is to expose a payload to both hyper- and microgravity under stable conditions during the same maneuver. The requirements for this profile will combine elements of one of profiles M1 through M4 with the additional requirement for stable hyper-gravity during the maneuver entry. Hyper-gravity requirements will range from 1.2 g to 1.8 g. Stability and accuracy will be as required by the microgravity portion of the maneuver. Duration of hyper-gravity will vary with the payload requirements. Transition from hyper- to micro-gravity shall occur over a 3 – 5 second period.

3.1.7 The Contractor shall provide flight services for payload verification and testing that do not plan for the minimum parabola quantities described in paragraph 2.0 Scope.

3.2 Aircraft Research Area

The contractor aircraft shall have a padded research area with a minimum floor area for experiment attachment of 350 square feet. The minimum available cabin height shall be 81”. This 81” minimum height shall be at least 32” wide (inboard/outboard axis) over the length (fore/aft axis) of the research area.

3.2.1 Experiment Attachment

The cabin area shall have provisions for the attachment of rigid experiment racks weighing up to 1400 lbs and measuring up to 96 inches in length, 60 inches in width. The aircraft floor and attachment provisions shall accommodate experiments with a maximum floor loading of 200 lbs. per square foot. The attachment provisions shall accommodate existing NASA experiment hardware using 3/8-24UNF, AN6 steel bolts, with a 20 inch on center mounting pattern. The attachment provisions shall secure the experiment racks under the emergency landing conditions as stated in Title 14 CFR Part 25.561. The

Contractor shall provide any necessary experiment mounting fixtures prior to the flight week in order to meet the flight week schedule.

3.2.2 Cargo Door

The aircraft shall be equipped with a cargo door into the aircraft cabin. The clearance through the cargo door shall be 72" high by 124" in length, as a minimum.

3.3 Crew Provisions

The aircraft shall be capable of seating the Contractor flight crew and up to 38 NASA or NASA sponsored persons. The aircraft shall have a private lavatory and two waste receptacles, which are suitable for the microgravity mission, and shall have in-cabin storage areas for crew personal items and emergency equipment.

3.4 Experiment Free Float Capability

The Contractor shall develop procedures for free floating of experiments. The procedures shall be reviewed and approved by NASA. The aircraft and flight crew shall accommodate free floating experiments weighing up to 400 lbs at 1g. Experiments may be free floated one at a time or simultaneously during zero gravity parabolic trajectories.

3.5 Research Electrical Power

3.5.1 Required Research Electrical Power Sources

Voltage	**Current**	*** Type**	**Receptacles Required**
28 VDC	15 Amp	Standard	3 per panel
28 VDC	35 Amp	Special	2
115 VAC, 400 Hz, 3 phase	35 Amp	Special	2
115 VAC, 60 Hz, 1 phase	20 Amp	Standard	3 per panel
115 VAC, 60 Hz, 1 phase	30 Amp	Special	2
115 VAC, 60 Hz, 3 phase	20 Amp	Special	2
230 VAC, 60 Hz, 1 phase	20 Amp	Special	2

* See Section 3.5.3 for type definition.

The aircraft shall be capable of supplying electrical power to the experiments mounted in the research test area. The following electrical power sources shall be available through dedicated receptacles for research hardware connection.

3.5.2 Total Available Research Electrical Power

The minimum total available power for each voltage source shall be:

Voltage	Total Available Current
28 VDC	120 Amps
115 VAC, 400 Hz, 3 phase	35 Amps
115 VAC, 60 Hz, 1 phase 115 VAC, 60 Hz, 3 phase 230 VAC, 60 Hz, 1 phase	*150 Amps (115VAC, 1 phase) (17.5 KW)

* The 115 VAC, 60 Hz, 1 phase, 115 VAC, 60Hz, 3 phase, and 230 VAC 60 Hz, 1 phase voltages may be derived from shared power sources. The minimum total available power from these sources must be 17.5 KW.

3.5.3 Research Power Panels

Aircraft research electrical power shall be available through dedicated research electrical power panels. The research electrical power panels shall be evenly distributed along the length of the research test area and shall have a maximum spacing of 10 feet between power panels and from each end of the research test area. The research electrical power panels shall contain electrical power receptacles. Each receptacle shall be labeled with the voltage and maximum current output. Each receptacle shall be individually circuit breaker protected at the panel and be capable of supplying the minimum current listed in section 3.5.1. All power panel receptacles shall be standard military specification (MS) cannon type receptacles, properly sized for the rated output voltage and current. Power panel receptacles shall be unique for each voltage, current, frequency, and phase to prevent misconnection of research hardware. Each research power panel shall contain a minimum of three receptacles for each Voltage/Current combination listed in section 3.5.1 as “Standard”. Each Voltage/Current combination listed in section 3.5.1 as “Special” must be present on a minimum of two research power panels. For each “Special” Voltage/Current combination, one receptacle shall be located on a power panel in the front half of the research cabin and the other “Special” receptacle shall be located on a power panel in the rear half of the research cabin. The two “Special” receptacles shall not be located on the same or adjacent power panels. The “Special” receptacles shall be evenly distributed amongst all research power panels. The panels shall be located and configured in such a way that power connections to the panel do not produce trip hazards and the panels shall not have sharp corners/edges. Provisions for Safety guards may be required. Conductive power panel materials shall be grounded to the aircraft frame.

Extension cords with integral Ground Fault Circuit Interrupters (GFCI) shall be provided for all 60 Hz connections in the quantities listed below. The extension

cords shall be of sufficient length to reach an experiment positioned anywhere in the research area. All 60 Hz research hardware connections shall be made through the GFCI protected extension cords. The extension cords shall mate to the standard military specification (MS) cannon type receptacle on the aircraft power panel end. The opposite end shall provide the following receptacle for the research hardware power interface:

Quantity Required	Power Source	NEMA Type Receptacle	Comments
12	115VAC, 60Hz, 20amp, 1 phase	5-20R	Straight blade, 3 wire (L,N,G)
2	115VAC, 60Hz, 30amp, 1 phase	L5-30R	Locking, 3 wire (L,N,G)
2	115VAC, 60Hz, 20amp, 3 phase	L21-20R	Locking, 5 wire (A,B,C,N,G)
2	230VAC, 60Hz, 20amp, 1 phase	L14-20R	Locking, 4 wire (L1,L2,N,G)

3.6 Compressed gas storage and supply

The aircraft shall be capable of flying up to 18 DOT approved "K" size high pressure compressed gas cylinders for the purpose of supplying gases for the operation of the experiments on board. The Contractor shall supply bottle holders and hardware to secure the bottles appropriately in the aircraft cabin. When providing bottle racks, each rack shall hold no more than 6 bottles.

3.7 Overboard Vent

The aircraft shall have the capability of venting experimental gases overboard. A minimum of 5 connections points on a single vent line shall be spaced throughout the length of the research area of the cabin. In addition, a second vent line, independent of the first, shall be provided to accommodate an experiment that cannot utilize the shared vent line due to the potential reaction with other vent gases. Vent exhaust ports shall be located so as not to reintroduce experiment gases into the cabin environmental control system, engine or APU intakes, or lavatory vents. The dedicated vent line shall have a least one connection point located in the research area of the cabin. Both vent lines shall be constructed from 1" stainless steel tubing. The connections points for both lines shall be located near the floor of the aircraft and shall be 1" male, 37 degree flare fittings conforming to SAE J514. The vent lines connections shall be sealed when not in use.

3.8 Research Area Display

Two or more displays shall be mounted in the research area and shall display the current parabolic trajectory number and vertical (z) axis acceleration to the nearest 0.01 g. The displays shall have of minimum update rate of 3 times per second and shall be driven by the accelerometer in Section 3.9. At least one of the displays shall be visible from anywhere in the research cabin area.

3.9 Accelerometer

The aircraft shall be equipped with a 3 axis accelerometer aligned to the vertical (z axis), thrust (x axis), and lateral (y axis) axes of the aircraft. The accelerometer shall be located +/- 10 feet, in the x axis, from the research area center. In cases where the NASA load plan precludes the accelerometer's location being placed +/- 10 ft from the research area center, the accelerometer may be placed at the nearest available location forward of the research area center. The accelerometer shall have a minimum range of +/- 2.5 g in the vertical axis, and +/- 1.0 g in the thrust and lateral axes. Signals from the accelerometer shall be available for input into as many as 6 research data systems simultaneously. The output signals from the accelerometers shall be analog voltage signals with a range of +/- 5 or +/- 10 volts, and isolated so that a short circuit on one output shall not interfere with the other outputs. The analog accelerometer signals shall have sufficient fidelity to resolve 1/1000 of a g. The accelerometer system shall be calibrated annually using a NASA approved calibration procedure to verify that the system is within tolerance.

3.10 Gravity Level Recording

The aircraft shall be equipped with a computer based data acquisition system, which shall record the gravity levels, as measured by the 3 axis accelerometer, during each parabolic trajectory. The recording system shall begin acquiring data before the initiation of the push over for the first parabola and shall record until the initiation of the aircraft pull out of the last parabola, and shall run continuously capturing both micro-g and hyper-g portions of each maneuver. The acceleration data shall be low-pass filtered and acquired at a minimum of 100 samples per second, per channel. Low pass filtering may be applied to the analog signal, the digitized signal or both, and shall have better than -3dB reduction at 50Hz. The analog to digital converter used to acquire the accelerometer signals shall have a minimum resolution of 16 bits. The data system shall have the capacity to store the 3 axis acceleration data for at least 60 parabolic trajectories. The data for each file shall be recorded sequentially in ASCII encoded comma or tab separated values (.csv) and shall consist of the following data: sample number, GPS time, Z acceleration, X acceleration, Y acceleration. In addition, the file for each parabolic trajectory shall include in a header the parabola number, target g level, total number of samples recorded, software version number, data acquisition unit identifier (serial number), and accelerometer serial numbers and calibration coefficients. The raw data collected for each flight shall be made available to the NASA COR in electronic format within two hours of the completion of each flight. Following the completion of the flight week the data from each parabolic trajectory from the flight week shall be provided to the NASA COR, as described in section 6.7.1 Gravity Level Reporting.

3.11 Aircraft Interior Lighting

The aircraft research area shall be equipped with adequate lighting such that both still and video photography can be accomplished without the need for supplementary lighting. The lighting shall provide sunlight quality illumination with a color temperature of 5600 K, +/- 100 K. The lighting shall provide a minimum of 1200 lux intensity as measured with a lux meter at the centerline of the aircraft, 40 inches above the floor.

3.12 Research Area Video Recording

The aircraft shall be equipped with 2 fixed digital video cameras that record research area activities during each flight. One camera shall be affixed near the front of the research area facing aft and the second camera shall be affixed near the back of the research area facing forward. Each camera shall be set up to view approximately one half of the research area, and the video recorders shall be capable of recording at least 4 hours of video in standard digital format.

3.13 Experiment Compatibility Analysis

The following historical documents are for reference only and do not represent current operations at either NASA AFRC or Johnson Space Center. The Contractor shall review these guides and notify NASA in writing of any experiment requirements that may conflict with their aircraft.

- JSC AOD 33912, Rev. C, "Interface Control Document NASA 932 C-9B"
- JSC AOD 33897, Rev. E, "Experiment Design Requirements and Guidelines for Microgravity Research"

4.0 AIRCRAFT OPERATIONS AND MAINTENANCE REQUIREMENTS

NASA intends to conduct microgravity flight operations as Civil Aircraft Operations only. Therefore, the Contractor shall be responsible for the overall safety of the microgravity aircraft operations and maintenance as well as full compliance with all applicable Federal Aviation Administration (FAA) regulations. NASA maintains a responsibility to verify that payloads and operations have been properly analyzed and reviewed to minimize risks to personnel and property. Therefore, the Contractor shall operate and maintain their aircraft per the NASA requirements within this document.

4.1 Aircraft Certification

The Contractor aircraft shall be operated throughout a Task Order in an airworthy condition as certified by the FAA and as verified by a formal NASA Airworthiness review board under the authority of a NASA Center Director using a NASA Airworthiness Review process. The Contractor shall possess and maintain a Title 14 CFR, Part 121 or 135 type certification valid for the duration of each Task Order.

4.2 Substitution of Aircraft, Approved Equipment, or Personnel

The Contractor may substitute aircraft, approved equipment, or personnel during performance of the contract provided each substitution is inspected and accepted in accordance with this Section 4.

4.3 Aircrew Qualifications

The Contractor shall provide the NASA AFRC Chief, Aircrew Branch (Chief Pilot) with

all aircrew qualifications. The Chief Pilot shall approve, in writing, the Contractor's aircrew. The approval process will include a review of the aircrew's training and currency records as well as observing crew performance during a microgravity flight by NASA civil servant(s). The approval will be valid for 12 calendar months unless suspended or revoked. NASA reserves the right to suspend or revoke aircrew approvals.

4.3.1 Primary Aircrew Qualifications

While annual renewals may be done during NASA microgravity flights, the initial approval may be completed outside of these flights for Pilot In Command (PIC), or may be conducted during the period of a Task Order at no cost to the Government using a dedicated training flight and not during a research flight. The Second In Command (SIC) may be initially approved during a NASA flight. Flight Engineers (FE) shall be approved during a NASA flight after observing at least one NASA flight to learn NASA specific communications between the cockpit and research area. Parabolic trajectories accomplished during NASA approval flights may be used for currency requirements as stated in PWS 4.4.8.1. Pilots shall meet the minimum qualifications listed below.

4.3.1.1 Pilots shall have at least an FAA ATP pilot certificate or military aircraft commander designation, and be type rated in the aircraft.

4.3.1.2 Pilots shall hold a NASA medical certificate issued under provisions of NPR 7900.3; NASA will provide the aeromedical examination and certification at AFRC at no cost to the contractor. The Contractor also has the option, at no expense to NASA, of providing a current FAA First Class Medical Certificate for each pilot to fulfill NASA medical certification requirements.

4.3.1.3 Pilots shall have accumulated the minimum flight time as follows:

4.3.1.3.1 1,500 hours total time in all aircraft.

4.3.1.3.2 100 hours total for both Pilot In Command (PIC) and Second In Command (SIC) in large aircraft during the preceding 12 months. PIC's must have flown at least 50 of those hours as PIC

4.3.1.3.3 10 hours and at least 100 parabolic trajectories for PIC in microgravity flight operations and 200 hours flight experience in aircraft type.

4.3.1.3.4 4 hours for SIC in microgravity flight operations and 50 hours in flight experience in aircraft type.

4.3.1.3.5 Upon written request by the contractor, NASA may grant waivers or exceptions to 4.3.1.3.3 and/or 4.3.1.3.4. The decision to grant or deny an exception or waiver shall be totally within the discretion of the NASA AFRC Director or Flight Operations

(DFO). NASA shall have the authority to limit any waivers or exceptions in any manner deemed appropriate by the DFO.

4.3.2 Secondary Aircrew Qualifications

4.3.2.1 Test Directors (TD) and Aeromedical Monitors (AM) shall have formal flight attendant training in aircraft type.

4.3.2.2 TDs and AMs shall hold a NASA medical certificate issued under provisions of NPR 7900.3; NASA will provide the aeromedical examination and certification at AFRC at no cost to the contractor. The Contractor also has the option, at no expense to NASA, of providing a current FAA Third Class Medical Certificate for each TD and AM to fulfill NASA medical certification requirements.

4.4 Flight Operations Manual

The Contractor shall operate the aircraft in accordance with a NASA approved Flight Operations Manual. Existing contractor manuals are acceptable if they meet, or are modified to meet the requirements of Title 14 CFR Part 121, NPR 7900.3C, and topics in this section, 4.4.

4.4.1 Flight Plans

4.4.2 Flight Following

4.4.3 Microgravity Flights

All microgravity maneuvers shall be conducted under daylight visual meteorological conditions (VMC) with a discernable horizon.

4.4.4 Flight Crew Duty Day

Maximum crew duty time is limited to 14 consecutive hours in multi-piloted aircraft followed by a 12-hour rest period. The rest period shall begin after leaving the place of work and terminate when reporting to the place of work for the next flight sequence. Requests for duty day extension beyond 14 hours (for multi-piloted aircraft), and/or reduction of crew rest following a 14 hour duty day below the 12 hour minimum shall be in accordance with NPR 1800.1C, Section 2.15 “Shift Work and Balancing Work-Rest Cycles” and DCP-X-046, “Fatigue Risk Management”. The DFO shall have final approval authority for any duty day extension. NASA may remove any Contractor personnel for fatigue before reaching their daily duty or flight limitations, at no cost to NASA, if the individual exhibits signs of significantly reduced performance capability. Such removal will be in consultation with the AFRC Chief Medical Officer.

4.4.5 Crew Manifesting

4.4.6 PIC Authority and Responsibility

The PIC is responsible for the safety of the aircraft, crew and equipment.

4.4.7 Crew Training

As a minimum the contractor shall incorporate the following into the training program for all crew positions:

4.4.7.1 Initial Checkout

The Contractor shall create a training syllabus specific for each crew designation (for example: PIC, SIC, Instructor Pilot (IP), Flight Engineer (FE), TD). Microgravity shall be one of the instructional elements and shall include ground and flight components. Typically, as an industry standard, initial training for pilots takes two to three weeks, with ground and simulator components. The syllabus shall identify whether the simulation training will be provided by a vendor or completed by the Contractor. Training requirements for aircrew trained prior to employment shall be addressed.

4.4.7.2 Upgrade Training

The Contractor shall create a training syllabus specific for each crew designation as required. Microgravity shall be one of the instructional elements. The plan shall identify whether the simulation training will be provided by a vendor or completed by the Contractor. Requirements for aircrew trained prior to employment shall be addressed.

4.4.7.3 Physiological Training

Prior to initial designation, primary crewmembers shall receive instruction in the physiological aspects of high altitude flight including altitude chamber indoctrination. Altitude chamber training received prior to initial designation shall satisfy this requirement. Refresher hypoxia training shall be accomplished every 5 years; training using a ground-level reduced oxygen breathing device (ROBD), combined with the academics component, fulfills this requirement. Refresher altitude chamber training is optional for primary crewmembers operating non-pressure suit operations.

Each primary crewmember shall receive land and water survival training every 5 years. Previous training such as military survival training courses, may be credited for this requirement. Newly assigned personnel, with no previous survival training, must complete this requirement within 6 months of being assigned to flight crew duties. Pilots may not be assigned as PIC until this requirement is satisfied.

4.4.8 Crew Requirements to Maintain Currency

The Contractor shall define aircrew currency requirements which shall, as a minimum, meet NASA Procedural Requirement (NPR) 7900.3C and 14 CFR Part 121. The crew shall also maintain the following currency:

4.4.8.1 Pilot Microgravity Flight Currency

Pilots, both Pilot in Command (PIC) and Second in Command (SIC) shall have flown at least one microgravity mission and a minimum of 10 parabolas in the preceding 90 days from the seat in which that pilot will fly during research missions. For exceptions see 4.3.

4.4.9 Aircrew Annual, Training/Evaluation Requirements

The aircrew annual requirements shall include the following, as a minimum, in order to meet the requirements of NPR 7900.3C. Annual evaluations shall be reviewed by the NASA Chief Pilot. The Chief Pilot may assign personnel to perform spot evaluations of operations as needed.

4.4.9.1 Pilots

4.4.9.1.1 Hours: 100 per year, PIC's must fly at least 50 of those as PIC

4.4.9.1.2 Annual Evaluations

The Contractor shall develop a syllabus outlining annual evaluations for PIC and SIC. The training shall be conducted in flight or a level B, C, or D simulator, as described in Title 14 CFR, Part 121, Appendix H, Advanced Simulation, and may include the instrument evaluation as part of the training syllabus. Evaluations conducted by Federal Aviation Regulation (FAR) part 142 Training Centers may also be used to satisfy pilot annual evaluations.

4.4.9.1.3 Instrument Evaluations

Instrument flying proficiency shall be evaluated at least once per year using professional aeronautical standards such as FAA Instrument Practical Test Standards.

4.4.9.1.4 Annual Test

An open book test shall be administered and reviewed annually by IPs to ensure current pilot knowledge of air traffic control procedures, aircraft systems, normal and emergency operating procedures, FAA regulation and pertinent NASA requirements.

4.4.9.1.5 Egress Training

4.4.9.2 Flight Engineers

4.4.9.2.1 Annual evaluations

4.4.9.2.2 Annual Tests

4.4.9.2.3 Egress Training

4.4.9.3 Test Directors & Aeromedical Monitors

4.4.9.3.1 Annual evaluations

4.4.9.3.2 Annual Tests

4.4.9.3.3 Formal flight attendant training in aircraft type, including egress training.

4.4.9.3.4 Maintain currency with First Aid/CPR/AED and Blood Borne Pathogen training

4.5 Aircraft Maintenance Manual

The Contractor shall maintain the aircraft in accordance with a NASA approved Maintenance Manual. Existing contractor manuals are acceptable if they meet, or are modified to meet the requirements of Title 14 CFR Part 121, NPR 7900.3C, and topics in this section, 4.5.

4.5.1 Minimum Equipment List (MEL)

The Contractor shall develop and use for all NASA flights an FAA or manufacturer approved MEL. The Contractor shall notify the NASA AFRC Director of Maintenance (DOM) immediately when there is an intention to fly with an inoperative MEL item, or when the MEL item has been appropriately cleared. The NASA DOM will consult with the NASA Director of Flight Operations (DFO), and the DFO will be the final approval authority for all MEL actions affecting NASA flights. Flight with inoperable MEL item requires DFO waiver and approval.

4.5.2 Aircraft Weight & Balance

The aircraft's required weight and balance data shall be determined by actual weighing of the aircraft equipped (1) within 12 calendar months preceding initial carding and (2) following any major repair or major alteration or change to the equipment list which significantly affects the center of gravity of the aircraft. All weighing of aircraft shall be performed on scales that have been certified as accurate within the 12 calendar months preceding the date of weighing. The

certifying agency may be any accredited weights and measures laboratory. A list of equipment installed in the aircraft at the time of weighing must be compiled. The equipment list will include the name of each item installed. Items that may be easily removed or installed for aircraft configuration changes (seats, doors, radios, special mission equipment, etc.) shall also be listed including the name and the weight and arm of each item. Each page of the equipment list must identify the specific aircraft by at least serial number or registration number of the aircraft. Each page of the equipment list will be dated indicating the last date of weighing or computation. The weight and balance must be revised each time new equipment is installed or old equipment is removed.

4.5.3 Microgravity Aircraft Minimum Equipment Requirements

4.5.3.1 Microgravity Guidance system

The Contractor shall provide a system that will enable the pilots to meet the requirements of section 3.1.

4.5.3.2 Intercom System

The contractor's intercom will enable the contractor Test Director, the contractor Aeromedical Monitor, and the NASA CM to communicate directly with the pilots and each other. The Contractor shall also provide an interface to the aircraft communication system in the research area. This interface shall provide an electronic connection to each voice loop on the aircraft. This interface shall provide TD, AM, and NASA CM the same communication functionality as provided to the aircraft cockpit crew on their audio selector panels.

4.5.4 Foreign Object Debris/Damage (FOD)

The Contractor shall have a Foreign Object Debris program in place for NASA to review and approve.

4.5.5 Tool Control Program

The Contractor shall have a tool control program in effect at their facility and at any field maintenance location where maintenance is performed.

This program shall meet the following requirements:

a) All tools shall be clearly marked with a company identification number or personnel name or number if privately owned.

b) The toolbox inventory shall be kept in the applicable toolbox.

c) The toolboxes shall be inventoried at the beginning and again at the end of each shift in which they were used.

d) Contractor owned or special tools shall be controlled in a similar manner and by a designated company representative or department.

e) Calibrated tools and equipment shall be maintained in accordance with established aircraft industry standards.

f) If a tool is lost, the Contractor shall locate the tool to ensure that the aircraft is airworthy.

4.5.6 Aircraft Mechanic Qualifications

The Contractor shall utilize mechanics with valid FAA mechanics certificates with airframe and power plant ratings, consistent with 14 CFR Part 65.

4.6 Aircraft Ground Operations

The Contractor shall provide for all necessary equipment and services required to conduct safe aircraft operations.

4.6.1 Aircraft Handling

The Contractor is responsible for all aspects of aircraft handling.

4.6.3 Shipping, Receiving and Storage

The Contractor shall accommodate the receipt and safe temporary storage of experimenter equipment, which may include hazardous materials. Arrangements with shipping companies for the delivery and pick-up of experimenter equipment will be the responsibility of NASA or the NASA sponsored experimenter.

4.6.4 Security

The Contractor shall protect the security of NASA personnel and equipment whenever these assets are within the Contractor's facilities or aircraft.

4.6.4.1 Security of Aircraft and Equipment

The Contractor is responsible for the security of their aircraft, vehicles, and associated equipment used in support of this contract.

4.6.4.1.1 Using the assistance of aircraft commanders, the Contractor shall develop physical security requirements tailored to the aircraft to be included in the Pilot's Aircraft Checklist.

4.6.4.1.2 The Contractor shall develop a procedure for reporting and responding to the unauthorized movement or taxiing of aircraft.

4.6.4.1.3 Aircraft Commanders shall:

4.6.4.3.3.1 Ensure security of their aircraft at transient domestic and international locations.

4.6.4.3.3.2 Prohibit unauthorized access to the Contractor's aircraft.

4.6.4.3.3.3 Ensure that passengers are properly identified and that baggage and packages are either associated with passengers or are authorized NASA cargo.

4.6.4.3.3.4 Reject unaccompanied or unidentifiable luggage or cargo and release to the custody of Airfield security forces for appropriate disposition.

4.6.4.3.3.5 Conduct appropriate security inspections of Contractor aircraft before placing it in service and after it has been left unattended.

4.6.5 Loading

The Contractor and NASA CM shall work together to develop an acceptable Flight Week Plan, as described in Section 6.1. The Contractor is responsible for loading the experiments and mounting them in the aircraft to meet the Flight Week Plan.

4.6.6. Fuel and Servicing Requirements

4.6.6.1 Fuel Requirements

4.6.6.1.1 All aircraft fuel and lubricating oils to be used by the aircraft during the contract period shall be supplied by the Contractor.

4.6.6.1.2 There shall be no refueling with NASA personnel on board or with engines running (hot) and NASA experiments on board.

4.6.6.2 Spill Clean-Up

The Contractor is responsible for compliance with local spill procedures. The Contractor shall be responsible for all cleanup of fuel, oil, and retardant contamination on airport ramps, retardant sites, parking areas, landing areas, etc., when caused by Contractor aircraft, equipment, or personnel. Fuel servicing vehicles shall carry sufficient petroleum product absorbent pad or materials to absorb or contain a 5- gallon petroleum spill. The Contractor is responsible for proper disposal of all products used in the cleanup of a spill in accordance with Environmental Protection Agency (EPA) requirements (40 CFR Parts 261 and 262).

4.6.6.3 Contractor Operated Fuel Facilities

Contractor operated fuel facilities shall comply with all applicable Federal, State, and Local laws. The Contractor shall meet all applicable regulations including: 14 CFR Part 139, and National Fire Protection Association (NFPA) standards.

4.6.7 Unloading

Upon completion of the final research flight of each flight week, all appropriate experiments shall be removed from the aircraft to meet the Flight Week Plan.

4.6.8 Government Supplied Equipment and Services

NASA will not provide Government owned facilities, equipment, or materials to the Contractor for use in connection with this contract.

4.6.9 Hangar and Work Spaces

Contractor hangar and work spaces provided for NASA and NASA sponsored personnel and experiments shall comply with all applicable Federal, State, and Local laws. The Contractor shall meet all applicable regulations including: 14 CFR Part 139, and National Fire Protection Association (NFPA) standards for the hangar and work spaces for NASA personnel and experimenters.

5.0 SAFETY

The primary purpose of the NASA Aviation Safety Program is to preserve human and material resources by the prevention of damage and injury through the elimination of aviation safety hazards throughout NASA and to enhance safety awareness in all NASA employees and Contractor personnel. These objectives are accomplished through the detection and elimination of hazards, safety awareness training, and enforcement of high standards of conduct and performance.

5.1 Applicable NASA Documents

See Section 2.1.

5.2 Aviation Safety Program Manual

The Contractor shall have an Aviation Safety Program Manual that addresses, as a minimum, all the requirements from NPR 7900.3C, Chapter 6. The Aviation Safety Program Manual shall be approved by NASA. The Contractor shall appoint an ASO who meets all the requirements of NPR 7900.3C, Chapter 6. The Contractor ASO shall be Safety Management System certified through an ICAO approved certification program.

5.3 Safety and Quality Oversight

During NASA flight weeks the NASA Aviation Safety Officer (ASO) and NASA Quality Assurance Manager (QAM) will work with the Contractor to assure safety and quality oversight. The NASA ASO/QAM will audit/verify Contractor compliance with NASA 7900.3C, Chapter 6.

5.4 Safety Reviews

Contractor safety reviews shall be comprehensive and cover all aspects of the Contractor's flight operation and NASA's experiments.

5.4.1 NASA Inter-center Aircraft Operations Panel (IAOP)

The Contractor shall be part of the NASA Inter-center Aircraft Operations Panel review program as described in Chapter 9 of NPR 7900.3C. At a minimum, an IAOP review will be conducted prior to commencement of flight operations for NASA and biennually thereafter. In addition, NASA may direct special reviews at any time during the contract period. IAOP Reviews are conducted at the Contractor's home base of operations. The Contractor shall implement all IAOP "Required Actions" prior to flight for NASA microgravity flight services.

5.4.2 Experiment Safety Approvals

The Contractor shall review all experiment payloads for safety and airworthiness per appropriate FAA standards and appropriate sections of NPR 8715.3C, NASA General Safety Program Requirements. The Contractor shall ensure that all experiments flown have received safety approval from the sponsoring NASA Center. Those Centers will be responsible for approving NASA sponsored qualified non-crewmembers. NASA AFRC will review the Contractor's payload analysis for concurrence.

5.4.3 Test Readiness Review (TRR)

The Contractor shall conduct a test readiness review of all experiments prior to aircraft loading. The purpose of the review is to ensure that the experiments and safety documentation are complete and in agreement with each other. NASA safety and airworthiness authorities will participate in the TRR.

5.4.4 NASA Aviation Safety Officer Reviews

The NASA ASO may conduct "no notice" reviews of the Contractor's aircraft, operations and equipment to ensure compliance with NPR 7900.3C, Chapter 6, Section 6.3.

5.4.5 Human Research and Institutional Review

Any research involving humans must adhere to all Department of Health and

Human Services (HHS) regulations (e.g. 45 CFR Part 46), and all other applicable regulations and guidelines (e.g. the Nuremberg Code of 1946, and the Helsinki Declaration of 1964, as revised in 1975, 1983, 1989) regarding the protection of human subjects in research. Specifically, all human research protocols must have the approval of a formal university-based or government-based Institutional Review Board (IRB) before commencing research on a microgravity flight. A copy of the IRB approval, as well as a copy of the research protocol and the informed consent document, shall be provided to the AFRC Chief Medical Officer prior to initiation of the research.

5.5 NASA Safety Reporting System (NSRS)

The Contractor shall ensure all employees are briefed on the use and availability of the NSRS. The link below explains all aspects of the program.

http://www.hq.nasa.gov/office/codeq/nsrs/index1.htm

5.6 Mishaps

5.6.1 Definitions

5.6.1.1 National Transportation and Safety Board (NTSB) Accident: As used throughout this contract, the following terms shall have the meanings as defined in 49 CFR Part 830.

Aircraft Accident Fatal Injury
Incident
Operator
Serious Injury
Substantial Damage

5.6.1.2 NASA Mishap Classifications as defined in NPR 8621.1B, Chapter 1, Figure 1:

Type A Mishap: 1) Total direct cost of mission failure and property damage is $2,000,000 or more, or crewed aircraft hull loss has occurred, or the occurrence of an unexpected crewed aircraft departure from controlled flight. 2) Occupational injury or illness that resulted in a fatality or a permanent total disability.

Type B Mishap: 1) Total direct cost of mission failure and property damage of at least $500,000 but less than $2,000,000. 2) Occupational injury or illness that resulted in permanent partial disability, or hospitalization for inpatient care of three of more people within 30 workdays of the mishap.

Type C Mishap: 1) Total direct cost of mission failure and property damage of at least $50,000 but less than $500,000. 2) Nonfatal

occupational injury or illness that resulted in days away from work, not including the day or shift on which it occurred, or restricted work; or transfer to another job, not including the day or shift on which it occurred; or hospitalization for inpatient care of one or two people within 30 workdays of the mishap.

Type D Mishap: 1) Total direct cost of mission failure and property damage of equal to or greater than $20,000 but less than $50,000 2) Any nonfatal OSHA recordable occupational injury or illness that does not meet the definition of a Type C mishap.

Close Call: 1) An event in which there is no equipment or property damage, or minor equipment property damage of less than $20,000, but which possesses a potential to cause a mishap. 2) No injury or only minor injury requiring first aid, but which possesses a potential to cause a mishap.

5.6.2 Mishap Reporting

The Contractor shall immediately, and by the most expeditious means available, notify the National Transportation Safety Board (NTSB) and the NASA ASO when an NTSB defined "Aircraft Accident" or NTSB reportable "Incident" occurs.

In the event of a NASA defined mishap or close call, the Contractor shall immediately, and by the most expeditious means available, notify the NASA ASO.

5.6.2.1 NASA Flight Week Mishap

The Contractor’s ASO and the NASA ASO will work together to complete the initial response and reporting defined in the Contractor’s Aviation Safety Program Manual. When conducting flight operations in support of NASA, the contractor shall notify the NASA ASO of all close calls, anomalies, and mishaps by the most expeditious means available. Notification of the NTSB will be made in accordance with the NPR 8621.1b by NASA.

5.6.2.2 Non-NASA Contract Mishap/Aircraft Accident/Incident Reporting

The Contractor’s ASO is responsible for all company, FAA, NTSB reporting and shall notify the NASA ASO within 5 days of the mishap, incident or aircraft accident.

5.6.3 Preservation Requirements

The Contractor shall not permit removal or alteration of the aircraft, aircraft equipment or records following an Aircraft Accident, Incident, or Mishap until

authorized to do so by the NASA ASO or other authorized NASA representative. Permitted exceptions to this requirement may be when life or property are threatened, when the aircraft is blocking an airport runway. The Contractor shall immediately notify the NASA ASO when taking such actions. The NTSB or FAA release of the wreckage does not constitute a release by the NASA ASO.

5.6.4 Mishap Investigations

Following a mishap, the Contractor shall ensure that pilots, mechanics or other personnel associated with the aircraft remain in the vicinity of the mishap until released by the NASA ASO or their designated representative. The Contractor shall cooperate with the Government during any investigation and make available personnel and aircraft records, and any equipment, damaged or undamaged, that the Government deems necessary.

5.6.4.1 Costs Related to Investigation

The Contractor shall be fully responsible for any cost associated with the reassembly, approval for return-to-service, and return transportation of any items disassembled by NASA.

5.6.4.1 Rescue and Salvage Responsibilities

The Contractor shall be responsible for the cost of search, rescue and salvage operations made necessary due to causes other than negligent acts of a NASA employee acting in the scope of his or her employment.

5.7 Aerospace Medicine

5.7.1 Aeromedical Physician & Registered Nurse

The Contractor shall appoint a physician, duly licensed to practice medicine in the state in which flight participants embark, to provide aeromedical screening, airsickness management, and oversight of participants in the microgravity flight program. The aeromedical physician shall provide evidence of sufficient education and training in the field of Aerospace Medicine so as to possess the requisite expertise in providing pre-flight screening and oversight services. (Prior service as an active duty military Flight Surgeon, and/or Board Certification in Aerospace Medicine would be one means of demonstrating such education and training). The flight medical physician must also be familiar with the specific physical and psychological stresses of microgravity flights; this familiarization is usually (but not necessarily) accomplished by participation in the microgravity flights themselves, on a periodic basis.

Additionally, the Contractor may choose to provide the services of a Registered Nurse (RN), if, for example, medication injections are utilized to manage airsickness (see below). In such cases the Registered Nurse shall be duly licensed in the state in which he or she administers the medication, and shall function

under the direct supervision of the Contractor's aeromedical physician. When on duty the RN must at all times have available a means of electronic, two-way, real-time communication (e.g. telephone and/or electronic mail) with the aeromedical physician.

5.7.2 Duties

5.7.2.1 Flight Participant Medical Screening

Microgravity flight participants shall undergo medical screening to ensure they are medically qualified for flight, i.e., there is no significant risk to personal health, flight safety or mission completion. Initial medical screening may be accomplished by means of a suitably designed questionnaire, such as one currently used by NASA for assessment of qualified non-crewmembers. (If using a non-NASA questionnaire, the questionnaire must have the concurrence of the AFRC Chief Medical Officer). When used, questionnaires shall be completed by the prospective participant, then sent (using appropriate privacy protections) to the Contractor's aeromedical physician, who shall determine whether or not that individual is medically qualified for microgravity flight participation (principles of medical qualification are outlined below). In some cases further evaluation of the prospective flight participant may be necessary, to include a physical examination and/or physical performance testing. The exact scope and frequency of the aeromedical evaluation protocol is left to the discretion of the Contractor; however, the aeromedical evaluation protocol must have the written concurrence of the AFRC Chief Medical Officer. Likewise, the aeromedical evaluation protocol shall ensure (with a reasonable degree of medical certainty) that an individual's current physical condition, medical treatment, and/or medication(s) shall:

a) Not pose a risk of sudden incapacitation (i.e. < 1% per year occurrence rate);
b) Not interfere with the individual's ability to perform their flight duties;
c) Not impact the safe operation of the aircraft;
d) Not interfere with the usage or effectiveness of personal safety equipment in the aircraft, including but not limited to oxygen equipment;
e) Pose minimal potential for subtle performance decrement, particularly with regard to the higher senses, including but not limited to vision, level of alertness, or cognition;
f) Be resolved or be stable and be expected to remain so under the stresses of the microgravity environment for the maximum duration of the certification period;
g) Not be exacerbated by nominal flight activities, including aircraft ingress/egress;

h) Not place the individual at significantly increased risk of injury during in-flight or ground emergency situations (including risk of injury during emergency egress);
i) Have first symptoms or signs that are easily detectable and not pose a risk to the individual or the safety of others, if the possibility of progression or recurrence exists; and
j) Not indicate pregnancy (Because the effects of parabolic flight on pregnancy outcome are unknown, pregnant women shall not be medically qualified for parabolic flight. Therefore, all female applicants will be queried as to their last menstrual cycle, and if pregnancy is known or likely, then flight participation must be delayed).

5.7.2.2 Airsickness Management

Airsickness, manifested by dysphoria, fatigue, lassitude, increased salivation, nausea, and in some cases emesis, is common on microgravity flights. Incidence rates of over 70%, of one degree or another, can be expected on first-time flight participants if no medical pre-treatment is given. Therefore, the Contractor shall utilize medical pre-treatment to manage airsickness. This pre-treatment shall be under the direct responsibility and authority of the Contractor's aeromedical physician, and shall specifically include a pharmaceutical component to prevent or reduce airsickness.

NASA has extensive experience in the management of airsickness on microgravity flights. One effective regimen, with the least overall side effects, entails the use of injectable scopolamine as the pharmaceutical component, using a weight-based adjusted dosing scale. However, other anti-nausea medication may be used instead. The Contractor's airsickness management protocol must receive the written concurrence of the AFRC Chief Medical Officer.

Any incident of airsickness, defined as the point where the affected individual must stop his or her activities (e.g. experiment), and/or there is active emesis, shall be reported in writing as a medical incident to the AFRC Chief Medical Officer. (Electronic mail would fulfill this requirement). The Contractor's airsickness management protocol shall maintain the rate of airsickness events to $\leq$ 10% of passenger-flights. The physician, RN, or a qualified designee shall provide in-flight aeromedical monitoring where additional care is required in the management of potential airsickness.

5.7.2.3 General Medical Support

The Contractor's aeromedical physician shall provide education regarding the physiologic aspects of parabolic flight, to consist of a formal didactic session no less than 30 minutes in duration, along with a

reasonable period of time for questions and answers. The didactic sessions must include education as to the signs and symptoms of airsickness, as well as methods to reduce or avoid such signs and symptoms. The flight participants must also receive proper instruction and training regarding the safety aspects of flights, particularly with regard to performing their experiments (if required) while restrained during the microgravity periods of flight.

5.8 Personal Protective Equipment (PPE) and Safety Equipment

In addition to the PPE and aircraft emergency equipment required by Title 14 CFR Part 121, the Contractor is responsible for providing the following PPE and aircraft safety equipment:

5.8.1 Smoke Hoods

Smoke hoods (AVOX Systems, PN802300-14 or equal) shall be provided by the Contractor for Contractor crew and NASA or NASA sponsored persons not otherwise served by standard passenger or crewmember supplemental oxygen systems.

5.8.2 Experiment Area Padding

The aircraft experiment area shall be padded, with flame retardant materials, in such a manner to prevent injury to personnel from the aircraft structure while performing microgravity maneuvers. For protection of personnel, the aircraft research area shall be padded with a minimum of 1" thick padding on the floor and 1/2" thick padding on all other surfaces. The aircraft research area shall be void of all sharp edges.

5.8.3 Flame Retardant Flight Suits

The Contractor shall provide flight suits made of fire-resistant polyamide or aramid material or equal for the NASA or NASA sponsored flight participants.

5.8.4 Automated External Defibrillator

The Contractor shall equip the aircraft with an aircraft approved automated external defibrillator.

5.9 Aircraft Cleanliness

The Contractor shall provide and maintain the aircraft interior in a clean manner, void of debris and surface contamination. The NASA COR will work with the Contractor to develop cleanliness standards. Likewise, the Contractor shall also have a plan (i.e. Infection Control Plan) for the safe cleaning and disposal of any body fluids (e.g. blood, vomitus) within the aircraft during and after flight. An appropriate protocol utilizing Universal Precautions (to include the proper use of personal protective equipment)

regarding blood or body fluids shall be utilized to minimize the risk of potential infection. The Contractor's Infection Control Plan shall receive the concurrence of the AFRC Chief Medical Officer.

6.0 MANAGEMENT AND ADMINISTRATION

6.1 Flight Week Planning

The Contractor and NASA CM shall work together to develop an acceptable Flight Week Plan. The plan shall include a day by day flight schedule broken down by the hour, the number, profile type, and gravity level for microgravity maneuvers on each flight, the Contractor's test readiness review schedule, loading/unloading schedule, crew and non-qualified crew member listing, list of experiments to be flown, floor plan(s), and any other necessary information. In order to meet NASA research requirements, the plan may include daily changes to the experiment load configuration on the aircraft. The NASA COR will propose an initial flight week plan and request a task plan 14 weeks prior to a flight week. The COR will accept the task plan through the issue of a Task Order. The Contractor shall request any other information necessary to complete the flight week plan. The Contractor shall finalize the flight week plan (confirm FAA approvals) no later than four weeks prior to flight.

The Contractor shall immediately notify the NASA CM of any changes to the flight week plan either before the flight week occurs (i.e. unscheduled maintenance or other factors which may cause a delay) or during a flight week (i.e. weather, unscheduled maintenance, crew illness, etc.).

6.2 Modifications to Flight Week Plan

NASA recognizes that any aircraft is subject to weather, unforeseen mechanical difficulties and a multitude of other factors that may affect the Contractor's ability to adhere to a standard flight week. In the event of such factors, the NASA CM and Contractor Project Manager shall work together in an attempt to satisfy the flight week requirements. Solutions such as two flights on one day or extending to Saturday have been satisfactory in NASA's experience. Modifications to the flight week plan are intended to ensure NASA's microgravity mission requirements are met.

6.3 Flight Week Meetings

Meetings between NASA and the Contractor along with their primary crewmembers are typically held at the beginning of each flight week and the morning of each flight day. The Contractor's primary crewmembers shall attend all meeting on the morning of the flight day in person. All other meetings shall be attended either in person or by teleconference. The meetings may include: Operational procedures, gravity level and sequencing, dispatch, flight following, hazard/risk assessment and reduction, airspace coordination, daily flight schedule, maintenance schedule, incident/accident reporting, test readiness reviews, and review of pertinent local procedures.

6.4 Contractor Aviation Safety Program, Operations, & Maintenance Manual Approvals

This PWS requires NASA approval of the Contractor's Aviation Safety Program, Operations, and Maintenance Manuals. Revisions to the manuals as a result of NASA discussions with the contractor shall be submitted to the NASA COR for approval within 30 days after contract award. No flight weeks shall be conducted prior to NASA approval of these manuals. The Contractor shall notify the NASA COR of any revisions to the Aviation Safety Program, Operations, or Maintenance Manuals. The Contractor shall submit revised manuals to the NASA COR for approval. Flight weeks shall be conducted using approved manuals only.

6.5 Performance Standards

6.5.1 Safety Performance

Safety performance is considered 100% satisfied when all elements of the NASA approved Aviation Safety Program, Operations, and Maintenance Manuals are adhered to, and there are no Contractor caused accidents or injuries.

6.5.2 Gravity Level Performance (GLP)

Gravity Level Performance is rewarded on the basis of the number of microgravity and/or hyper gravity maneuvers that meet the specifications in PWS paragraph 3.1.

Gravity level performance may be measured against a modified standard due to causes outside the Contractor's control. The COR may modify pass/fail criteria of individual parabolas due to factors such as NASA requested non-optimal trajectories or NASA acceptance of non-optimal weather conditions. The NASA COR will have final authority to approve adjustments to the gravity level performance standard.

6.5.3 Flight Week Performance (FWP)

Flight Week Performance is considered 100% satisfied when the flight week plan (or modified flight week plan) is adhered to.

Flight week performance will be adjusted if the flight week plan is not met due to Contractor caused delays (i.e. lack of crew availability, equipment unavailability, equipment malfunction or inability to meet flight safety requirements). Flight day compensation will be adjusted if:

1. A flight is aborted after a portion of the parabolas have been performed.

2. A flight is cancelled.

Flight week performance may be measured against a modified plan when the plan was modified due to causes outside the Contractor's control (i.e. weather or

NASA caused delays). The NASA COR will have final authority to approve adjustments to the flight week performance standard.

6.6 Measurement and Reporting of Performance

6.6.1 Measurement of Research Flight Time

Research flight time shall be measured from the time the aircraft commences its take-off roll until it returns to the blocks. Research flight time shall be measured in hours and tenths of hours. The Contractor shall report research flight time as per 6.8.5

6.6.2 Measurement of Gravity Level

The Contractor shall measure gravity level as per 3.9 and 3.10, and report gravity level as per 6.7.1. NASA may also use their own G-level measurements to verify gravity level performance. NASA gravity measurements will have precedence over Contractor data. In cases where the Contractor load plan precludes the NASA accelerometers location being placed +/- 10 ft from the research area center, the NASA accelerometer may be placed at the nearest location forward of the research area center.

6.7 Technical Reporting

6.7.1 Gravity Level Report

The Contractor shall provide a report detailing the gravity level of each microgravity maneuver during a flight week. The report shall also provide analysis of the gravity levels and compare the data to the contract performance standards for gravity level, 6.5.2. The format and content of the report shall be approved by the NASA COR. Raw accelerometer data shall be provided in electronic format to the NASA COR within two hours of the completion of each flight. The Gravity Level Report shall be provided to the NASA CO and NASA COR within 1 week of Flight Week completion.

6.7.2 Flight Day Reporting

At the completion of each flight day, the Contractor shall provide a Flight Day Report to the NASA COR and CM which includes a summary of microgravity maneuver count, desired g levels, narrative of incidents or issues which may have occurred on the flight, and any other highlights from the flight crew. The format and content of the report shall be approved by the NASA COR.

6.7.3 Video Report

The Contractor shall provide a DVD copy of in-flight video taken from the fore and aft view video cameras in the research area. The video DVD format shall be approved by the NASA COR. The video shall be provided to the NASA COR

within 3 weeks of flight week completion.

6.7.4 User's Guide

The Contractor shall provide a user's guide describing the microgravity aircraft facilities, aircraft interfaces, test equipment requirements, integration procedures, and safety procedures within 8 weeks of contract award. The user's guide shall be similar to JSC AOD 33912, Rev. A, "Interface Control Document NASA 932 C-9B" and JSC AOD 33897, "Experiment Design Requirements and Guidelines NASA 932 C-9B". The user's guide shall be approved by the NASA COR, and shall be made available to the public via internet in PDF format.

6.8 Operations Reporting

6.8.1 The Contractor shall, 5 working days prior to the flight week, send the NASA Chief Pilot a currency report that illustrates by hours, landings, approaches, and training dates that an assigned crewmember meets the currency requirements set forth in the Contractor flight operations manual.

6.8.2 The Contractor shall provide annual aircrew evaluation reports to the NASA Chief Pilot.

6.8.3 The Contractor shall notify the NASA DOM whenever modifications to the aircraft are proposed or made.

6.8.4 The Contractor shall develop a NASA COR approved report which tracks fuel use for both ferry flights and research flights. The Fuel Use Report shall be provided to the NASA CO and NASA COR within 1 week of Flight Week completion.

6.8.5 The Contractor shall develop a NASA COR approved report which tracks flight hours for research flights. The flight hours shall be measured as per 6.6.1 and 6.6.2. The Flight Hour Report shall be provided to the NASA CO and NASA COR within 1 week of Flight Week completion.

6.8.6 The Contractor shall immediately notify the NASA DOM of any repair following an incident or accident, including the circumstances involved.

6.8.7 The Contractor shall report to the AFRC Chief Medical Officer all incidents of airsickness, as well as the ongoing *rate* of airsickness events (i.e. #incidents/#passenger-flights), as referenced in Section 5.7.2.2 above.

6.9 Key Personnel

The Contractor shall provide to the NASA COR a list of the Contractor's key personnel and a means of contacting these individuals in the event of an emergency or during off-hours. The Contractor shall notify the NASA COR of changes in the list of the Contractor's key personnel within three (3) working days. The Contractor shall identify these key personnel as a minimum:

6.9.1 Project Manager

The Contractor shall appoint a Project Manager with the authority for all coordination and direction of activities.

6.9.2 Contractor Aviation Safety Officer

The Contractor ASO shall be responsible for safety oversight during NASA flight weeks, and shall interact with the appointed NASA ASO on all safety matters.

6.9.3 Chief of Flight Operations

The Contractor shall appoint a Chief of Flight Operations with the responsibility for meeting NASA's flight operation requirements.

6.9.4 Aeromedical Physician

The Contractor shall appoint a physician to provide aeromedical screening, airsickness management, and oversight of flight participants. The Contractor shall be responsible for aeromedical oversight during NASA flight weeks.

6.10 Authority of NASA Representatives

6.10.1 Contracting Officer

The NASA CO is responsible for all contractual issues, including issuing and funding of Task Orders. Other responsibilities are stated in the FAR and this contract.

6.10.2 Contracting Officer's Representative

The NASA COR is authorized to take any or all actions necessary to ensure compliance with the technical portions of the contract. The NASA COR will conduct all requested or required inspections.

6.10.3 NASA Aviation Safety Officer

The NASA ASO will monitor the Contractor's safety oversight during NASA flight weeks. The NASA ASO will interface directly with the Contractor's Aviation Safety Officer on matters of safety, mishaps, and close calls.

6.10.4 NASA Quality Assurance Manager

The NASA QAM will monitor the Contractor's quality oversight during NASA flight weeks. The NASA QAM will interface directly with the Contractor's Quality Assurance Manager on matters of quality.

6.10.5 NASA AFRC Director of Flight Operations

The NASA DFO will monitor the Contractor's aircraft operations under this contract. The DFO is responsible for ensuring the Contractor's compliance with their Aviation Safety Program, Operations Manual and Maintenance Manual, and is the sole approval authority for issuing waivers.

6.10.6 NASA Campaign Manager

The NASA CM will work with the Contractor to develop and implement the flight week plan. The NASA CM will monitor flight week plan performance and the accomplishment of NASA flight objectives. The NASA CM will attend each flight week and participate in each flight. The NASA CM has go/no go authority regarding experiment readiness before each flight.

6.10.7 NASA AFRC Chief Medical Officer

The NASA AFRC Chief Medical Officer will monitor the Contractor's aeromedical oversight during NASA Flight Weeks. The NASA (AFRC) Chief Medical Officer will interface directly with the Contractor's Aeromedical Physician on matters involving aeromedical practice.

6.10.8 NASA AFRC Chief, Aircrew Branch (Chief Pilot)

The Chief Pilot will monitor Contractor flight crew currency and proficiency for compliance with NASA requirements.

6.10.9 NASA AFRC Director of Maintenance

The NASA DOM will monitor Contractor aircraft maintenance operations for compliance with NASA requirements.

6.11 Proprietary Rights

6.11.1 Government Furnished Data and Materials

NASA shall retain unlimited data rights and privileges in all Government furnished data and materials. The Contractor shall neither retain nor reproduce for private or commercial use any data or other materials furnished under this contact. The Contractor agrees not to assert any rights at common law or in equity or establish any claim to statutory copyright in such data. These rights are not exclusive and are in addition to any other rights and remedies to which NASA is otherwise entitled elsewhere in this contract.

6.11.2 Confidentiality of Data

Duplication or disclosure of the data, photographic and video images, and other information to which the Contractor will have access as a result of this contract is

prohibited. It is understood that throughout performance of this contract, the Contractor will have access to confidential data, which is either the sole property of the NASA or is the sole property of other than the contracting parties. The Contractor and his Subcontractor(s) (if any) agree to maintain the confidentiality of all data to which access may be gained throughout contract performance, whether title thereto vests in the NASA or otherwise. The Contractor and his Subcontractor(s) (if any) agree to not disclose said data, any interpretations and/or translations thereof, or data derivative there from, to unauthorized parties in contravention of these provisions, without the prior written approval of the NASA CO or the party in which title thereto is wholly vested. Subcontractor(s) are subject to the same stipulations and may be held responsible for any violations of confidentiality.

7.0 APPENDICES

APPENDIX A
DEFINITIONS AND ACRONYMS

AFRC	Armstrong Flight Research Center
ASO	Aviation Safety Officer
CFR	Code of Federal Regulations
CM	Campaign Manager
CO	Contracting Officer
COR	Contracting Officer Technical Representative
DFO	Director of Flight Operations
DOM	Director of Maintenance
DOT	Department of Transportation
FAA	Federal Aviation Administration
FOD	Foreign Object Debris/Damage
FWP	Flight Week Performance
g	Unit of gravitational acceleration
GLP	Gravity Level Performance
IAOP	Inter-center Aircraft Operations Panel
IRB	Institutional Review Board
JSC	Johnson Space Center
MEL	Minimum Equipment List
NASA	National Aeronautics and Space Administration
NSRS	NASA Safety Reporting System

NPD	NASA Policy Directive
NPR	NASA Procedures and Requirements
NTSB	National Transportation Safety Board
PPE	Personal Protective Equipment
QAM	Quality Assurance Manager
PWS	Performance Work Statement
TD	Test Director
TRR	Test Readiness Review